



Task Force 2
Our Common Digital Future: Affordable, Accessible
and Inclusive Digital Public Infrastructure



THE VISION OF A DIGITAL PUBLIC INFRASTRUCTURE FOR AGRICULTURE

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Abstract



Agriculture faces the competing challenges of enhancing productivity and raising the incomes of smallholder farmers, while simultaneously also addressing concerns related to environmental sustainability. Digital technologies have the potential to tackle these challenges and transform agri food systems in unprecedented ways. This policy brief advocates for the conceptualisation


and development of digital public infrastructure for agriculture for a more equitable and responsible development pathway for agriculture in the G20 countries. The brief highlights the role of the G20 and the need for leadership, financial backing, and orchestration of initiatives across stakeholders to realise this vision while also stressing the need for public-private partnerships, ethical safeguards, and strong governance mechanisms.



The Challenge



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Agriculture in the Global South remains the primary catalyst for achieving prosperity for a majority of its citizens, while also contributing to the fulfilment of the first of the Sustainable Development Goals (SDG) by lifting people out of poverty and creating a world free from hunger. Agriculture and allied activities are more than just livelihoods for women and men. They have positive impacts on promoting healthy nutrition among adolescents and adults, serving as a safety net against food insecurity and offering ecosystem services. The technologies and institutional processes introduced in the early 1960s and 1970s yielded significant outcomes in raising productivity and attaining food self-sufficiency in certain countries. However, the interventions and their intended impact have gradually plateaued since then.

In today's world, we face competing challenges. On the one hand, agricultural development is expected to enhance the productivity of smallholders, raising their incomes while also addressing concerns related to environmental sustainability. Agriculture uses 85 percent of India's fresh water and 46 percent of its land, making it crucial to address these

issues. Additionally, agriculture also plays a vital role in providing ecosystem system services such as carbon sequestration.¹ Achieving a balance between these competing challenges and ensuring a demand-driven agri food system necessitates the development of new tools, processes and capabilities. These should enable decision-makers and stakeholders to understand the intricacies of the highly dynamic and interconnected system variables and factors that characterize complex agri food systems. By doing so, they can effectively respond with appropriate actions to address the multifaceted problems faced by agri food systems, both at the on-farm and off-farm levels.²

Unlike interventions of the past that were mostly on-farm, digital technologies are spawning innovations on-farm as well as at multiple points in the agri food systems value chain.³ The digital revolution in agriculture has a much broader scope, encompassing various aspects such as agri supply chains, access to finance and markets, contextual advisory services, and establishment of farmer networks. Advances in data collection, computing technologies and analytics enable an unprecedented opportunity to re-imagine agriculture production and distribution.⁴



Digitalisation results in the entry of new actors and institutions into agriculture innovation systems and the deployment of a digital agriculture service or product need an ecosystem of actors to work seamlessly. Digitalisation of agriculture is largely driven by the private sector—“new”-generation agriculturists and startup entrepreneurs keen to apply the benefits of technology such as the Internet of Things, blockchain, and machine learning and artificial intelligence (ML/AI) to make agriculture operations efficient across the value chain.


How digitalisation can impact farmers and agri food systems in the Global South

Digitalisation of value chains can deliver benefits like financial inclusion and better market access for smallholder farmers as well as improve their access to extension services.⁵ Jensen’s seminal study of Kerala fishermen provided a clear identification of the significant impact of cell phones on earnings, price volatility and waste reduction.⁶ Aker’s work on small-scale African farmers also showed significant time and cost savings by using information and communication technology for extension services.⁷

Improving accessibility and timelines of dissemination of weather and market information can help farmers adapt their management to climate change impacts and build their resilience.⁸ Receiving climate information, especially about impending weather events, can help farmers take pre-emptive actions and minimise crop-production losses from weather and climate-induced events.⁹ The penetration of mobile phones as well as advances in mobile wireless technologies create unique opportunities to reach remote and underserved farmers.¹⁰

Information and data on food production, certification and value-chain traceability are becoming very important, and digital technologies enable feedback from end consumers to all upstream actors in the value chain.¹¹ Digitalisation can make crop and livestock production more efficient and sustainable and create beneficial outcomes for farmers, consumers and the society at large.¹²

This brief argues that without “context-neutral” digital public goods (DPGs) and open datasets—also referred to as building blocks—digital agriculture products and services can only be created by either governments or large private sector firms as expensive, full-



stack implementations and therefore cater only to large farmers who can pay for such digital services. Such a pathway towards the digitalisation of agriculture could lead to unintended consequences and inequitable outcomes. The authors refer to India's experience with building digital public infrastructure (DPI) as well as the India Digital Ecosystem for Agriculture (IDEA) vision to propose a digital public infrastructure for agriculture (DPI4A) vision for G20 countries.

India's DPI experience and the IDEA vision

India has taken a lead globally in leveraging DPI for the benefit of its citizens in a PPP mode. Almost all sectors of the economy, including financial services and direct benefit transfers (DBTs) to the neediest, witnessed significant benefits, as demonstrated during the COVID-19 pandemic. Additionally, the seamless nationwide rollout of vaccination highlighted the efficacy of these systems.

The government of India's efforts to also bring the digital revolution to agriculture was articulated through a concept called IDEA.¹³ The IDEA concept paper published in 2021

serves as an inspiration for the DPI4A vision but this paper addresses issues beyond the ideas touched upon by IDEA. This paper explores issues of digitalisation accelerating as well as creating new inequities and exclusion of smallholders, and how context-neutral building blocks and DPIs could lead to more equitable outcomes and a PPP model of digital agriculture products and services. The paper also offers insights into the potential pitfalls of a full stack approach and articulates how a DPI4A with requisite governing principles, could be the path to achieve an ecosystem approach as espoused by the IDEA paper.

The vision: An overview of the proposed DPI4A

The proposed DPI4A is a comprehensive solution to address critical bottlenecks of an agri food systems in the Global South and address some of the inherent challenges that full-stack implementations might create. Significant capital investment should be directed towards the development of backend data processing, computing and hardware infrastructure, which can be packaged as a DPI built jointly by the government and the stakeholders in the ecosystem. Such a



public platform embraces the cardinal principles of interoperability, inclusivity, affordability and accessibility. It must be a collaborative effort building on the strengths of the private and the public sectors, a PPP model where private sector investments can be crowded in to realise the development objectives of the public sector. DPI4A facilitates both tactical and strategic decision-making processes by leveraging multi-year and multi-source information, aggregated from the individual farms to state and national levels. DPI4A efficiently handles large volumes of diverse agricultural datasets and employs tools such as video, voice, and vernacular translation to enhance farmer engagement. By doing so, it fosters platform economies and enables a wide array of digital innovations spanning the entire agri food systems value chain. These innovations are developed by a range of actors, including small- and medium-sized AgTech companies as well as large incumbent agri-businesses.

Translating the vision into a reality

An Open DPI4A “AgriStack”—envisioned as an enabling framework of services (applications) and agri data around a

data exchange—is needed to support several use cases, while encouraging data and application interoperability using application programming interfaces (APIs). Given agriculture’s intricate complexities and intersection with every other sector, such as finance, supply chain, manufacturing, water and chemicals, it is impossible to conceive of a monolith platform to adequately serve its needs. Hence, there are three fundamental building structures that come together to translate the vision into reality.

The first is several open-sourced, freely accessible “minimalistic”, discrete, building blocks with open content, which are secure and scalable nationally, as DPGs, to help make DPI4A a reality. DPGs necessarily must be co-created, well-governed and transparent to earn the trust of the community and farmers. Some DPGs could be repurposed from other sectors, while some new ones may have to be conceived as well. Therefore, it is necessary to adopt the DPG for DPI4A approach, which is the focus of this paper.

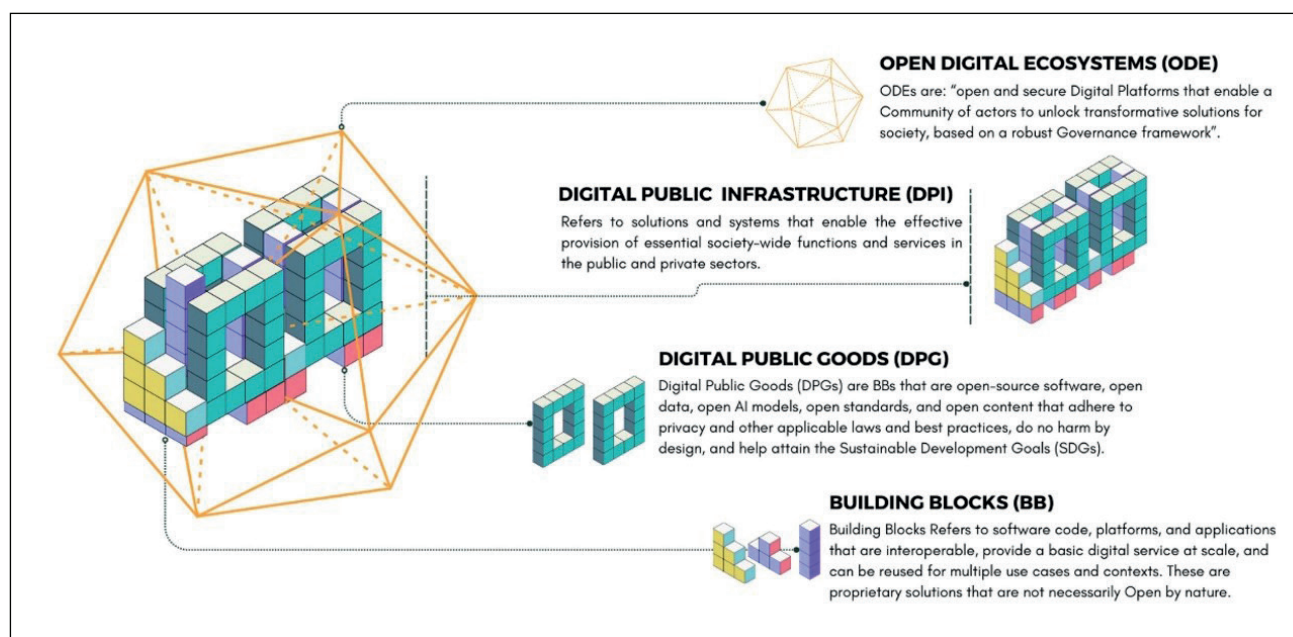
The second aspect to focus on, for the sake of completeness, is open agri data, which is the raw material for almost all

the use cases, as well as for leveraging deep technologies like ML/AI. Due to the lack of standardisation, calibration and certification, most agri datasets are ineffective for use and hence deemed untrustworthy. Sound data interoperability policies are of utmost importance to improve “data trust” and farmer adoption. Similarly enabling data portability protects farmer interests when switching service providers.

The third is the DPI4A itself, which is an API-driven open framework that intricately leverages DPGs and agri data and reduces duplication by integrating data sources and a vast backend of new and existing applications.

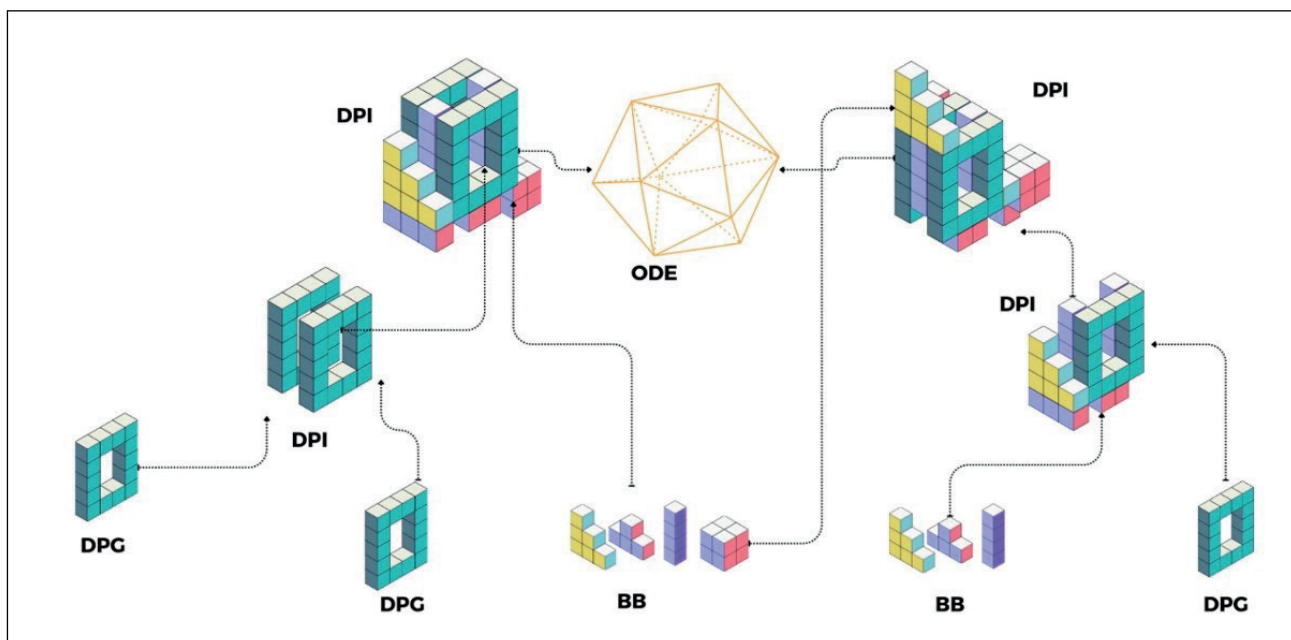
DPGs are not solutions on their own but enable other solutions, such as DPI and very often smaller DPIs along with other DPGs, to come together to form larger DPIs as can be seen in Figures 1 and 2.

Figure 1: Definitions of a well-designed digital stack



Source: Synthesised by authors from Digital Public Goods Alliance and others

Figure 2: Structure of a digital stack



Source: Synthesised by authors from Digital Public Goods Alliance and others

Governance for DPI4A


While DPI4A can break down data silos and create shared technology infrastructure, it is a unique experiment in public-private citizen collaboration to deliver innovative solutions. It can also raise concerns about privacy, data-driven behavioural manipulation, identity theft and fraud.

Hence, in translating the articulated vision into reality, DPIs should not only be based on a strong technological foundation but also adhere to the highest standards of ethical

governance that follow core values and principles. Dr Pramod Varma, a leading architect of several population-scale DPIs, identifies six “first principles” for using a DPI approach to problem-solving that were used while designing digital infrastructure.¹⁴

This policy brief proposes the following core pillars for such a governance system.

- There is full transparency in governance.
- The platform is open source and inclusive, embracing diverse



stakeholders in the ecosystem. It is agnostic to small, medium and large actors. It also must be language, crop and region agnostic to embrace the diversity of agricultural operations.

- DPI4A is based on mutual trust among all stakeholders. This is key to the success of a common infrastructure when dialogue between governments, private and the citizen sector is not always congenial and healthy.
- The core belief is to co-create, collaborate and thrive on the spirit of partnership. Thus, working in silos and standalone efforts must give way for a participatory and

collaborative mode of working thereby avoiding duplication and one-upmanship.


- The platform spurs innovations, improvisations and learning. There is a huge interest among startups in addressing critical bottlenecks. Incubation and venture support of new solutions and cross-sectoral learning from successes in other areas—UPI, ONDC and others—needs to be promoted.
- Data security and privacy rights of individuals are core values and must be respected with built-in checks and balances to ensure privacy.



The G20's Role

2





Agriculture was introduced in the G20 under the French presidency in 2011. The Paris Ministerial Declaration of June 2011 spelt an elaborate action plan on food price volatility and agriculture.¹⁵ The meeting also decided to launch an Agricultural Market Information System. This action plan prioritised food security and addressing food price volatility as some of the key challenges for the global community. It highlighted five key objectives as directions for future work:

- Improve agricultural production and productivity
- Increase market information and transparency
- Strengthen international policy coordination
- Improve and develop risk management tools for all stakeholders
- Improve the functioning of agricultural commodities' derivatives markets.

The journey from Paris 2011 to Bali 2022

The G20 summits from Paris to the 2022 summit in Indonesia were dominated

by discussions on various concerns, including food security and nutrition, sustainable resource use in agriculture, volatility in international and domestic food prices, the looming threat of climate change on agriculture and allied activities, the growing role of women in agriculture, and asymmetric market information among stakeholders. Simultaneously, new opportunities for sustainable solutions became a salient feature of the G20 declarations showing pathways to the international community to tackle the abiding challenges faced by agriculturists. Specifically, the Bali declaration of 2022 mentioned digital agriculture as one of the potential solutions:

Innovative Agri-preneurship through Digital Agriculture to Improve Farmers' Livelihood in Rural Areas 16. We recognize that research, innovation, technical progress, and the use of digital technology in agriculture carry the potential to further revolutionize food systems by contributing to improve resilient and sustainable food production. We acknowledge the gaps in respect of technology viability, accessibility, and affordability. We highlight the importance of collaboration among national and international



research institutions and adequate funding to develop and scale innovations, including digital agriculture technology, through private and public pathways to give farmers around the world the widest range of options to achieve their aspirations. We emphasize the importance of digital transformation in agriculture alongside other innovations to improve farmers' livelihoods through enhanced productivity and production in a sustainable manner, and broadening market access and opportunities.¹⁶

Leadership role of G20 countries in 2023 and lessons from India's successes in DPI

India's G20 presidency in 2023 offers a unique opportunity to build further on the discussions over the last twelve years beginning with the Paris Declaration. While the consensus is clearly on problem articulation and the vision for sustainable agriculture, what was missing was a clear roadmap to achieve these. There were indeed some breakthroughs in identifying solutions; however, those were either not comprehensive enough embracing all the stakeholders of the ecosystem or addressing the entire value chain.

The world after the COVID-19 pandemic has demonstrated the potential power of digital interventions in mitigating and responding—if not overcoming—to some of the crises, be it in health, education, citizen care, financial inclusion and mental health. Breakthroughs in technology such as Generative AI are now a reality. The startup social enterprise sector attempting to address social deficits is now a global phenomenon. Global and domestic philanthropy is accelerating the flow of funds to agriculture and other sectors. India's experiences during the pandemic are significant in ensuring the vaccination of over one billion citizens and recording each dose of vaccination, thanks to the massive deployment of digital tools. DBT of food grains to 800 million of its citizens and ongoing expansion of digital payment systems through the UPI route are two other examples of the reach, scale and impact of a publicly built digital infrastructure. India has provided technical assistance to at least five other countries on the UPI success story. These are all live examples of a country using public digital infrastructure to deliver public goods at scale and efficiency. A unique aspect of India's experience with building and scaling DPI has been through the forging



of successful partnerships between public and private ecosystems across sectors. Thus, the time is opportune to


implement DPI4A. G20 countries under India's presidency are well poised to take this leap of faith.



Recommendations to the G20

3





The vision articulated in this brief is attainable with concerted and dedicated investments from the G20 countries. To translate this vision into reality, this paper makes the following recommendations:

- Member countries can constitute an inter-ministerial group and task forces to orchestrate efforts of several domain-expert institutions, such as CGIAR centres, and other reputed research organisations that are well placed to pool their global and regional knowledge. The task force could identify potential building blocks or DPGs, enabling DPI4A globally and further developing reference architectures for realising them.
- Donor harmonisation and grant investments with longer time horizons of five to 10 years are a prerequisite to working on this vision as well as creating the DPGs that are identified. The G20 could create platforms or venues to channel such donor funding, grant money or patient capital into building DPGs.
- The G20 can take the lead and involve all stakeholders and create synergies of positive actionable ideas emanating from the private,

public and citizen sector as also research institutions across the globe, multi-lateral and UN organisations and philanthropies.

- The G20 could take the lead and build farmer-centric DPI in agriculture ensuring data privacy, transparency and the highest standards of ethical governance.
- The G20 could ensure and facilitate concurrent and real-time learning and knowledge exchange as countries in the Global South embark on the path of building a DPI4A.
- The G20 could provide thought leadership to the countries by pooling best practices that will guide the next practices in DPI4A, such as Aadhaar and UPI in India. It can help create a time-bound action plan that is backed by adequate resources to achieve the vision.
- The G20 must also advocate for the thoughtful development of DPI through a whole-of-society approach, which includes providing technical assistance. This approach ensures that digital cooperation safeguards human rights, contributes to governments' digital sovereignty and is grounded in local digital ecosystems.¹⁷

Attribution: Ram Dhulipala, Nipun Mehrotra, and Ajit Kanitkar, "The Vision of a Digital Public Infrastructure for Agriculture," *T20 Policy Brief*, June 2023.

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